settings are reversed. In alternative embodiment, valves 216, 218, 220, and 222 are not utilized and sensor 208 is located in reservoir 232.

Please delete the paragraph starting on page 6, line 13, and ending on page 6, line 15, and beginning with the words, "A pump" and substitute therefor the following paragraph.

A pump 230 draws fluid from a reservoir 202 and delivers it through heat exchanger 228, where it is cooled to the required temperature. A relief valve 234 protects heat exchanger 228 from overpressure.

Please delete the paragraph starting on page 6, line 25, and ending on page 6, line 28, and beginning with the words, "Heat load" and substitute therefor the following paragraph.

Heat load 206 receives the fluid, precisely regulated at the desired temperature and flow setpoints, and adds heat to the process fluid, raising its temperature except for when the heat-load is temporarily off. The fluid then returns to reservoir 202.

Please delete the paragraph starting on page 7, line 1, and ending on page 7, line 8, and beginning with the words, "Figure 3" and substitute therefor the following paragraph.

Figure 3 is a schematic illustration of a temperature control apparatus 300 for achieving precision temperature control of fluids. A temperature controller 344 compares its setpoint to the value from a sensor 342, and uses that comparison to control the position of flow control valves 326 and 352, which determine the mixing ratio of hot and cold sources from reservoirs 328 and 302. Flow control valves 326 and 352 positions are inversely related; as valve 326 opens, valve 352 closes, and vice versa. The inverse relationship is accomplished with dual signals from controller 344, with one valve being controlled with inverse logic compared to the other.

Please delete the paragraph starting on page 9, line 8, and ending on page 9, line 14, and beginning with the word, "Reservoir" and substitute therefor the following paragraph.

Reservoir 402 is sized to provide the appropriate amount of thermal inertia for the system. In one embodiment reservoir 402 includes a circulation pump to reduce thermal stratification within the reservoir. Manual valves 416 and 418 are normally closed, while manual valves 420 and 422 are normally open. In an alternative embodiment, these settings are reversed if facility backup cooling is used. A variable displacement pump 424 draws fluid from reservoir and delivers it to the final control location.

Please delete the paragraph starting on page 13, line 11, and ending on page 13, line 13, and beginning with the words, "The method" and substitute therefor the following paragraph.

The method of calculating a particular application's required distinct points of resolution is displayed in Design Variation #1, and illustrated in the following sample calculation.

Please delete the paragraphs starting on page 14, line 4, and ending on page 14, line 12, and beginning with the words, "ΔFlow/ΔTemp" and substitute therefor the following paragraphs.

$$
\begin{aligned}
\Delta Flow/\Delta Temp &= [Flow_{total} * (T_{hot} - (T_{nom} - .01)) / (T_{hot} - T_{cold})] - Flow_{cold} \\
&= [39gpm* (88°F - (75°F - .01°F)) / (88°F - 73°F)] - 33.80gpm \\
&= 0.0260gpm/.01°F
\end{aligned}
$$

$$
\begin{aligned}
Valve\ Travel\% &= 100*(\Delta Flow/\Delta Temp / Flow_{cold}) \\
&= 100*(.0260gpm/.01°F / 33.80gpm) \\
&= 0.077\%
\end{aligned}
$$

Please delete the tables and calculations starting on page 14, line 21, and ending on page 16, line 23, and beginning with the first column header entitled, "Deviation" and substitute therefor the following tables and calculations.

Design Variation #1

| DEVIATION | TEMP F | | FLOW % | | GPM | | DGPM/.01 | % | REQUIRED |
| COLD HOT | COLD | HOT | COLD | HOT | COLD | HOT | MIX | VALUE TRAVEL | RESOLUTION |
|---|---|---|---|---|---|---|---|---|---|
| NOM/NOM | 73 | 88 | 86.67 | 13.33 | 33.80 | 5.20 | 0.0260 | 0.077 | 1500 |
| LOW/LOW | 72 | 87 | 80.00 | 20.00 | 31.20 | 7.80 | 0.0260 | 0.083 | 1500 |
| LOW/HIGH | 72 | 89 | 82.35 | 17.65 | 32.12 | 6.88 | 0.0229 | 0.071 | 1700 |
| HIGH/LOW | 74 | 87 | 92.31 | 7.69 | 36.00 | 3.00 | 0.0300 | 0.083 | 1300 |
| HIGH/HIGH | 74 | 89 | 93.33 | 6.67 | 36.40 | 2.60 | 0.0260 | 0.071 | 1500 |
| | | | | | | | | | **1700** |

Design Variation #2

| DEVIATION | TEMP F | | FLOW % | | GPM | | DGPM/.01 | % | REQUIRED |
| COLD HOT | COLD | HOT | COLD | HOT | COLD | HOT | MIX | VALUE TRAVEL | RESOLUTION |
|---|---|---|---|---|---|---|---|---|---|
| NOM/NOM | 70 | 87 | N/A | N/A | 40.00 | 39.00 | 0.0769 | 0.128 | 780 |

Flow valve's resolution based on valve sized for 100% open at 60 GPM      **780**

Design Variation #3

| DEVIATION | TEMP F | | FLOW % | | GPM | | DGPM/.01 | % | REQUIRED |
| COLD HOT | COLD | HOT | COLD | HOT | COLD | HOT | MIX | VALUE TRAVEL | RESOLUTION |
|---|---|---|---|---|---|---|---|---|---|
| NOM/NOM | 73 | 88 | 86.67 | 13.33 | 33.80 | 5.20 | 0.0260 | 0.260 | 385 |
| LOW/LOW | 72 | 87 | 80.00 | 20.00 | 31.20 | 7.80 | 0.0260 | 0.260 | 385 |
| LOW/HIGH | 72 | 89 | 82.35 | 17.65 | 32.12 | 6.88 | 0.0229 | 0.229 | 436 |
| HIGH/LOW | 74 | 87 | 92.31 | 7.69 | 36.00 | 3.00 | 0.0300 | 0.300 | 333 |
| HIGH/HIGH | 74 | 89 | 93.33 | 6.67 | 36.40 | 2.60 | 0.0260 | 0.260 | 385 |

Hot flow valve's resolution based on valve sized for 100% open at 10 GPM      **436**

Design Variation #4

| DEVIATION | TEMP F | | FLOW % | | GPM | | DGPM/.01 | % | REQUIRED |
| COLD HOT | COLD | HOT | COLD | HOT | COLD | HOT | MIX | VALUE TRAVEL | RESOLUTION |
|---|---|---|---|---|---|---|---|---|---|
| NOM/NOM | 73 | 88 | 86.67 | 13.33 | 33.80 | 5.20 | 0.0260 | 0.260 | 385 |
| LOW/LOW | 72 | 87 | 80.00 | 20.00 | 31.20 | 7.80 | 0.0260 | 0.260 | 385 |
| LOW/HIGH | 72 | 89 | 82.35 | 17.65 | 32.12 | 6.88 | 0.0229 | 0.229 | 436 |
| HIGH/LOW | 74 | 87 | 92.31 | 7.69 | 36.00 | 3.00 | 0.0300 | 0.300 | 333 |
| HIGH/HIGH | 74 | 89 | 93.33 | 6.67 | 36.40 | 2.60 | 0.0260 | 0.260 | 385 |

Hot flow valve's resolution based on valve sized for 100% open at 10 GPM      **436**

NOTE:    A low value of required resolution is desirable because it produces higher sensitivity.

*Example Calculations for Design Variation #5:*

Given: A user must remove 350kW @ -100°F from a cold plate. Design ambient condition is 100°F. Based on an analysis of potential refrigerants, ethane is selected due largely to operating at reasonable pressures and a high heat of vaporization.

Design Variation #5

| | | | | Customer Load = 350 kW | | |
|---|---|---|---|---|---|---|
| | ETHANE | | | Qcust = 1.19E+06 Btu/hr | | |
| CYCLE POINT | T (°F) | P (pisa) | H (Btu#) | liq/vap (mass %) | Dens (#/ft$^{3)}$) | |
| 1 | 100 | 31.3 | 468 | - | 0.16 | |
| 1c | 280 | 175 | 534 | - | - | |
| 1' | 120 | 175 | 466 | - | - | |
| 2 | 240 | 1500 | 465 | - | - | |
| 2' | 120 | 1500 | 346 | - | - | |
| 3 | 0 | 1500 | 252 | - | - | |
| 4 | -100 | 31.3 | 252 | - | - | |
| 4V | -100 | 31.3 | 389 | 0.33 | | |
| 4L | -100 | 31.3 | 187 | 0.67 | 32.7 | |
| 5 | (from graph, use h5 below) | | | | 0.88 | |

Dh (hex cold side)     =      dh (hex warm side)
                             =      (h2'-h3)
                             =      **94.0**

dh (hex cold side)     =      x(hl-h4V) + (1-x)(h1-h5)
94.0                      =      x(hl-h4V) + (1-x)(hl-h5)
solving for h5... h5     =      **366.6**

solve for quality @ point 5 (shown in table)

dh (cust load)     =      h5-h4L
                        **179.6**

dm/dt (liquid loop)     =      Qcust / dh(cust load)
                        **6649**   #/hr